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GROWTH OF LOCAL RICE GENOTYPES PLANTED CENTER PADDY PRODUCTION IN WEST SUMATERA

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Abstract

Growth of genotype local rice is very important to develop in any environment especially in paddy production centers area. Growth performances especially biomass and yield of seven genotypes of rice were evaluated at four locations in west sumatera. The experiment was carried out in Solok, Bukittinggi, Pariaman and Pesisir Selatan district. The seven genotypes were planted in a randomized block design with four replications. Data were analyzed using analysis of variance. Result of experiment showed there are interactions between genotype and location on biomass and yield. Cantiak Manih and Mundam genotype planted in Pesisir Selatan had the highest biomass among the other genotype, while Ciredek, Bakwan and Sarai Serumpun had the highest biomass when planted in Bukittinggi. Cantiak Manih planted in Solok is the highest yield among the others genotypes. All of the genotype had higher yield when planted in highland.

Key words: growth, local rice, genotype, west sumatera.

INTRODUCTION

Rice is the main food source for people in Indonesia. Population growth rate of 1.38% in the 2010-2015 period [1] are relatively lower compared with 1.49% during the period of 2000-2010 [2]. Nevertheless, the number of Indonesian population of 238.5188 million in 2010 will remain elevated to 255.461 million in 2015 [1]. These conditions was resulted by increase need of rice. To fulfill needs of the demand for rice in the future, various attempts have been made by the government through the extension or intensification. Extension effort was blocked because of limited land. Therefore, intensification is still the right choice to balance the increase in national rice requirement.

One of the components in rice cultivation technology is used to improve varieties. Between 1971 and 1986 has released 62 rice varieties result from introduction and plant breeders in Agricultural Research and Development Center [3]. During 1960-2000 more than 90 improved varieties have been released by Ministry og Agriculture [4]. In 2011, 17 new improved varieties were released [5]. Scince the green revolution is practiced in Indonesia, some of local varieties increasingly losing. The area cultivation local varieties in the period 1972 to 1979 was reduced from 42% to 30%. The percentage of local varieties of land area in 1986 was estimated at less than 20%[6]. Although the area of land planted with local varieties reduced in large numbers, but in certain areas local varieties are still dominant in farmers planting.Twenty five local rice varieties are still cultivated by local farmers in Solok West Sumatra [7].

Preservation of local varieties due to several factors such as higher selling prices and the rice texture suitable for local society [7]. In general, consumers of rice in Indonesia prefer soft rice structure with 20-24 % amylosa content [8]. In contrary, consumers in Medan and Makassar, prefer non-sticky cooked rice, while consumers in Java prefer sticky and soft-cooked rice [9]. Population of West Sumatra also like rice with non-sticky or amylose content greater than 24% [10]. The new improved varieties released by governments generally have the rice. Sixteen new high yielding varieties are released by the government in 2011, all of these have the sticky and soft-cooked rice texture [11]. This condition causes new improved varieties does not developed in West Sumatra [10].

Despite improving varieties have high yield potential, however, the results of some local varieties able to reach the results of improved varieties. New improved variety Batang Piaman grown in Coral Endah West Lampung has grain yield 4.19 t / ha [12]. This yield is lower than the local variety Ceredek Putiah from Tanjuang Balik Solok which is producing 4.8 tones grain / ha [13]. Therefore, some local varieties are still popular in West Sumatra. Farmers in West Sumatra still plant local varieties such as Ciredek, Anak Daro, Kuriak Kusuik, Irkasuma, Siliah Baganti, Mundam, Saratuih Gantang, and others [14]. Kuriak Kusuik dominant cultivated by farmers in Bukittinggi. Mundam is dominate in wetland farmers Padang Pariaman. While Anak Daro and Ceredek widely grown in the area of Solok [15].

Plant growth is basically influenced by genetic and environmental. Appearance of a gene is affected by the environment. Genetic and environment interactions occur due to genetic differences in the ability of using the influence of different locations [16]. This has led to inconsistent results in any environment. Conversely, stable genetic varieties are not much influenced by environmental factors. Therefore, these varieties can be grown in a variety of environments.

Lines or varieties could be stable when it has a little diversity when grown in different environmental conditions or their diversity remains in various environments [17]. Thus a stable varieties will provide growth and yield responses that are relatively similar despite different environment. Based on this condition, the research has been conducted to study the response of the growth and yield of local rice varieties to plant locations in West Sumatera.

RESEARCH METHOD

The location of experiment were Koto Baru (Solok), Biaro (Bukittinggi), Lubuk Alung (Padang Pariaman) and Suguntur (Pesisir Selatan) . Mean annual rainfall during the study was the highest in the Pesisir Selatan (275.4 mm) followed by Pariaman (254.6 mm). The mean rainfall was lowest in Bukittinggi (137.8 mm) then by SMF . Seven local genotypes namely Ciredek, Anak Daro, Randah Putiah, Cantiak Manih, Mundam, Bakwan and Sarai Sarumpun were used in this study. The Ciredek and Anak Daro adapted genotypes in Solok , Randah Putiah and Cantiak Manih adapted in Bukittinggi, Mundam comes from Padang Pariaman and both Bakwan and Sarai Sarumpun comes from the Pesisir Selatan. The trials were managed by farmers, practice land preparation, weeding and other management Prepare the land three weeks before transplanting to ensure the fast and ideal growth of the rice to be planted . This will hinder the early growth of weeds and help in proper management of fertilizer and farm irrigation. Plow the land then harrow the land once a week after plowing it and repeat this

process after a week has passed . Level land with the use of plowshare. Puddling a seedbed done 15 days before seed sowing. Prior to seed sowing, seeds are soaked in water. Floating seeds disposed, while the immersed put in a cloth bag or a plastic bag and immersed 48 hours. Furthermore, seeds removed and brooded for 12 hours [18]. Germinated seeds that have been spread evenly on the surface of seedling media and press gently so immersed. Before the seeds are sown, seedbed given fertilizer urea 10 grams per square meter. Irrigate the seedbed after 2-3 days with a depth of 2-3 cm . Keep the seedbed well Irrigated until the day when the seedlings will be pull out . Keep the soil damp up until a week after transplanting . During the early vegetative stage , it is fit that the water depth is at 2-3 cm. Raise the water level to 5-7 cm during the reproductive stage and keep it at that level until the grains are milky . The rice paddy is drained 1-2 weeks before harvesting.

All trials were laid out in a randomized block design with three replications in each location. In each trial, the plot size was 3 m × 3 m and 3 weeks old seedlings were transplanted with 25 cm × 25 cm spacing and 3 seedlings per hill. Sintetic fertilizers was applied at a rate of 200, 100 and 100 kg ha -1, for N, P2O5 and K2O respectively. Nitrogen was applied three times at the time transplanting, at tillering (21 day after transplanting) and flowering stage (42 day after transplanting). All of P2O5 and K2O was applied as basal dressing at the time transplanting. Hand weeding was done after 3 and 6 weeks after transplanting. Pest and diseases control by applying of pesticide [19].

Start harvesting the rice when 80-85 % of the grains are already ripe. Data were recorded on biomass and grain yield of net plot . Dry grain yield is determined by taking the grain 16 hill / plot, dried in the sun until the water content of 14 % , then weighed [19] . Biomass crops are determined by taking a sample of 6 hill / plots in a systematic way . Each cluster sample cut at ground level with the help of the cutter . Revenue cuts, then put in plastic bags and brought to the Biology Laboratory of Padang State University. Samples are transferred into paper and dried in an oven at 70^{o}C for 48 hours . Samples are weighed with Ohaus 310 [19] . Climate data especially the day and night temperature measured by mercury thermometer . Rainfall recorded from the nearest meteorological station . Nutrien soil analysis conducted on Nitrogen (N), Phosphorus (F) and Potassium (K). Data were analyzed by analysis of variance followed by DNMRT at the level of 5 % [20]

RESULT AND DISCUSSION

Location research has environmental variation primarily in altitude, temperature, rainfall and soil nutrient content. The maximum and minimum temperature difference at four locations. The highest average temperature found in the Pesisir Selatan, then Padang Pariaman, Bukittinggi and Solok. The highest rainfall found in the Pesisir Selatan, then Padang Pariaman, Solok and Bukittinggi. The average number of rainy days is found in Bukittinggi, Padang Pariaman, Solok and Pesisir Selatan. Climatic conditions during the study can be seen in Table 1.

Table 1.Temperature (^{o}C) and precipitation at the location of experiment

minimum temperature	21	24	20	25
maximum temperature	31	34	30	35
average temperature of the morning	24	26	23	27
average daylight temperature	28	31	29	32
average night temperature	23	26	24	25
average precipitation (mm/month)	190,6	254,6	137,8	275,4
average of rainy days (month)	12	13	16	12

Soil nutrient content of the four studies are also various. Nutrient content consits of nitrogen, phosphorus and potassium. Pariaman is the highest compared with the other locations. Nutrient content is not relatively significant among Solok, Bukittinggi and Pesisir Selatan. Nutrient content in the study area can be seen in Table 2.

Table 2. Content of Nitrogen, Phosphorus and Potassium in the study site

Nutrien	Location			
	Solok	P. Pariaman	Bukittinggi	Pesisir Selatan
N (%)	0,33	0,57	0,26	0,30
P-PO4 (ppm)	8,10	23,10	9,90	8,50
K-HCl (ppm)	2,12	9,94	2,82	3,37

Plant Biomass

Statistic analyze showed that interaction between location and varieties affect biomass significantly. The highest biomass was found on Cantiak Manih variety (71.41 g) that was planted in Pesisir Selatan and give the same results on Mundam (71.03 g) that was planted on the Pesisir Selatan. (33.47 g). The results of the lowest biomass was found in varieties Bakwan and Sarai Sarumpun which also planted in Solok. The results of varieties and location interaction on biomass plant can be seen in Table 3.

Table 3. Average Biomass average (g) of seven local rice varieties planted at four locations in West Sumatra

Varietas	Location			
	Solok	P.Pariaman	Bukittinggi	Pesisir Selatan
Ciredek	55,19	50,53	59,80	55,69
Anak Daro	53,03	46,93	57,77	63,37
Randah Putiah	52,96	50,83	58,55	65,73
Cantiak Manih	57,14	57,30	66,69	71,41
Mundam	48,36	47,85	46,91c	71,03
Bakwan	33,47	52,09	61,47	51,60
Sarai Sarumpun	39,39	54,27	64,74	53,55

Numbers followed by the same letters in the column and rows are not different significantly at 5% level according to DNMRT

The high biomass of Mundam Cantiak Manih in Pesisir Selatan indicate that both of that varieties are not specific adaptation. Cantiak Manih which is local varieties only grown in Bukittinggi, it also growth better when planted in Pesisir Selatan.The similar data was found in Mundam varieties derived Padang Pariaman, produce the same biomass when grown in Solok . An interesting case of this variety produced biomass higher when grown in the Pesisir Selatan and Bukittinggi.The data means that Mundam varieties have been developed only Pariaman actually widely adaptable at least in four locations. Even the highest biomass is found in the Pesisir Selatan. Among three rice genotypes Cisadane, Ciliwung and Memberamo planted at three locations in South Sulawesi, only Memberamo widely adapted in all locations [21]

Ciredek is local varieties derived from Solok. Ciredek is one of the Solok local varieties that have potential to be developed into a superior local varieties because their results are quite high [13]. Nonetheless, this variety also suitable developed in Pesisir Selatan and Bukittinggi. The producing of biomass did not differ compared with the location of Solok. Thus, the variety has wide adaptability and can be developed in the Pesisir Selatan and Bukittinggi

The low biomass of Bakwan and Sarai Bakwan in Solok because of both varieties comes from Pesisir Selatan . An interesting thing is the biomass produced by two varieties originating from Pesisir Selatan was higher when grown in Bukittinggi. That data shows that adaptation of two varieties are broader and not specifically adapted . This is also supported by the fact that the two varieties give the same biomass from the origin of the two varieties in the Pesisir Selatan. Thus, both these varieties can also be developed in Bukittinggi and Padang Pariaman. Instead, Solok area is not suitable location for the development of both these varieties. In addition, the low biomass of bakwan and Sarai Sarumpun in Solok compared to Bukittinggi related to temperature. Temperatures in Solok relatively higher than Bukittinggi effect on plant respiration High temperatures will accelerate rate of plant respiration. In contrast , plant growth per unit of leaf tends to be higher if plants are grown in a low temperature [22]. High air temperatures will reduce the size of the plant dry weight and plant seeds [23]

Biomass plant reflects status and amount of nutrients that are absorbed by plant and rate of photosynthesis of a plant is the result of buildup of photosynthetic. Accumulation of plant biomass reflecting the organic compounds that result of synthesis inorganic compounds from water and carbon dioxide that contributes to plant dry weight [24]. Although the planting location Pariaman shows the content of N, P and K is the highest among the four locations, but did not correlate positively with the biomass produced. The condition is due genotype and environment interaction significantlyon plant biomass. The lack of contribution to the nutrient content of plant biomass due nutrient needs of plants suspected to be sufficient with the apply of nutrients in the form of fertilizer.

Grain Yield

Interaction between varities and locations effect dry grain significantly. The highest dry grain yield was found in Cantiak Manih varieties grown in Solok (476.90) and the lowest was found in Sarai Sarumpun (129.67), Bakwan (133.03) and Anak Daro (150.43) planted in Padang Pariaman) . Interaction between varieties and locations on the grain yield is shown in Table 4.

Table 4. Yield dried grain (g/m2) of seven local rice varieties planted at four locations in West Sumatra.

Varieties	Locations			
	Solok	P. Pariaman	Bukittinggi	Pesisir Selatan
Ciredek	391,70	248,73	334,07	357,20 opqrstuv
Anak Daro	325,67	150,43	367,07	318,07 klmno
Randah Putiah	334,80	312,03	348,13	281,07 ghijk
Cantiak Manih	476,90	266,60	313,83	308,53 k
Mundam	359,50	333,67	412,40	246,73 defg
Bakwan	218,83	133,03	324,30	266,10 fghi
Sarai Sarumpun	225,80	129,67	386,23	240,73 def

Numbers followed by the same letters in the column and rows are not different significantly at 5% level according to DNMRT

An interesting point of this study is Cantiak Manih variety derivad from Bukittinggi give a higher yield if planted in Solok and the lowest yield found in Padang Pariaman. Grain yields obtained in Bukittinggi same cultivation in the Pesisir Selatan . The data indicate that these varieties are not location specific and include varieties that are genetically stable . According to Lines or varieties said to be stable when it has a little diversity if planted in different environmental conditions. Thus, stable varieties will give results the same response despite different environment. In contrast, unstable varieties will give different responses to environmental change [17]. Bukittinggi and Solok are suitable for planting of Anak Daro, Kuriak Kusuik and Cisokan varieties because they grain yield higher than Pariaman [25].

The highest dry grain yield varieties were also found at Ciredek if planted in Solok and equal to Pesisir Selatan. The lowest yield obtained in Pariaman. Ciredek planted in Bukittinggi provide dry grain yield equal to the Pesisir Selatan. Ciredek only grown by farmers in Solok area and not found in other areas. High yields of these varieties related to adaptation of these varieties are classified as specific. Ciredek proposed as one of the superior varieties for specific location in Solok area [13].

Anak daro variety gives high dry grain yield in Bukittinggi (367.07 g/m2) and the lowest in Padang Pariaman. Anak daro give the same results if planted in Solok and Pesisir Selatan . Field observations indicate that Anak Daro spread across all rice production in West Sumatra . Nevertheless , Bukittinggi is an area that suitable for the highest grain yield. Conversely, the lowest yield obtained in Pariaman . Although the nutrient content of the soil at the planting site Pariaman , but these conditions do not directly affect grain yield . This is presumably because of genetic Anak Daro unstable , so only high yields in Bukittinggi . Although so far the varieties grown in almost all production centers , but due to the good taste the difference in results is not only one consideration for the farmer to be planted this variety.

Randah Putiah provides the same dry grain yield if planted in Bukittinggi, Solok and Padang Pariaman. It shows that these varieties are not location specific that adapted in Bukittinggi. Thus, varieties normally grown only in Bukittinggi can be developed also for paddy rice production center in West Sumatra except for the Pesisir Selatan region. Varietas Mundam from Pariaman have the same result if planted in Solok. It obtained the highest yield when planted in Bukittinggi (412.40 g/m2). Thus, these varieties also include a broad group of varieties that adapt at least three locations on the planting. Location Pesisir Selatan is not suitable for producing mundam variety because the results were lower than from their origin. Bakwan (324.30 g/m2) and Sarai sarumpun (386.23 g/m2) are the two lowest yielding varieties at planting location Pariaman. This is understandable, because this variety is cultivated in the Pesisir Selatan area. Nevertheless, the results of this varieties is higher when planted in

Bukittinggi compared with the results achieved from his home in Pesisir Selatan area. Thus this variety also belong to a group is actually adaptable widely because only Solok area unsuitable for the production of this varieties.

Based on dry grain yield of seven varieties planted at four locations, in general Solok and Bukittinggi is the location that gives a higher yield than the location of Padang Pariaman and Pesisir Selatan. One of the environmental factors that lead to low grain yield in Padang Pariaman and Pesisir Selatan is climate especially temperature. Although the nutrient content in Padang Pariaman highest compared with the other three locations, but the yield are lower compared with other locations.

The difference of yield between two regions are more affected by climate than land [26]. Higher temperatures in Padang Pariaman and Pesisir Selatan affect plant respiration. Plant respiration increases with increasing temperature. Grain yield declined by 10% for each 1°C increase in growing-season minimum temperature in the dry season [27]. High respi ration rate will reduce the amount of assimilates available for growth and yield. Physiological activity to acumulate photosynthate on wheat decreased at higher temperatures [28]. In addition, the activity of enzymes involved in starch synthesis is also seen to decrease in high temperature conditions [29]. Studies on rice productivity under global warming also suggest that the productivity of rice and other tropical crops will decrease as global temperature increases [30].

CONCLUSION AND SUGGESTION

Based on the results of the study it can be concluded that the biomass and yield some local varieties that have been cultivated limited to certain areas , it can be developed in other production centers in West Sumatra . In addition , also known specific adaptation of variety. Based on dry grain yield, Ciredek varieties that have been grown only in Solok also be developed in Pesisir Selatan. Randah Putiah only planted in Bukittinggi can be extended to the area of Solok and Pariaman . Cantiak Manih from Bukittinggi is also adaptive to Solok and Pesisir Selatan. Mundam comes from Padang Pariaman also adaptive to the planting in Solok and Bukittinggi. Bakwan and Sarai Sarumpun from Pesisir Selatan also gives the same yield or higher if grown in Solok or Bukittinggi . Anak Daro varieties that have been found in all the centers of rice production in West Sumatra, was adapted specifically to the area of Solok and Padang Pariaman . Data obtained from the study only analyzed to determine the variety and environmental interactions. Therefore , the data should be analyzed further to determine veriety stability.

REFERENCES

[1] BPS. 2012a. Proyeksi Penduduk Indonesia 2010-2035. BPS. bps.go.id (Akses 1 April 2014)

[2] BPS. 2012b. Laju Pertumbuhan Penduduk Menurut Propinsi. BPS. bps.go.id (Akses 1 April 2014)

[3] Harahap, Z. Dan T.S. Silitonga. 1987. Pemuliaan Padi: Suatu Studi Kasus Pemanfaatan Plasma Nutfah. Makalah disampaikan pada Diskusi Panel 3 Hari Plasma Nutfah, Jakarta 12-14 Februari 1987.Djunainas, Susanto dan Kasim. 1993. Deskripsi Varietas Unggul Padi 1943-1992. Puslitbangtan, Bogor.

[4] Hadi, S., T. Budiarti and Haryadi. 2005. Study on Comercialization of Released Lowland Rice Variety. Bul. Agron. (33)(1):12-18

[5] Puslitbangtan. 2011. Varietas Unggul Baru. Berita Puslitbangtan. No. 49.
[6] Siwi, B.H. dan S. Kartowinoto.1990. Plasma Nutfah Padi: Padi Buku 2. Badan Penelitian dan Pengembangan Pertanian. Pusat Penelitian dan Pengembangan Tanaman Pangan, Bogor.
[7] Anhar, A. 1996. Kelestarian Plasma Nutfah Padi Lokal Pasca intensifikasi (Studi Kasus di Kabupaten Solok, Sumatera Barat). Disertasi. Program Pascasarjana . Universitas Indonesia.
[8] IRRI. 1979. Annual report for 1978. International Rice Research Institute. Los Banos, Philippines; 478
[9] Rachmat, R., R.Thahir, And M. Gummert. 2006. The Empirical Relationship Between Price And Quality Of Rice At Market Level in West Java. Indonesian Jurnal og Agriculture Science. 7 (1) : 27-33
[10] Atman, 2007. Varitas Unggul Baru Padi Sawah Batang Lembang. Deskripsi dan Teknologi Budidaya. Jurnal Ilmiah Tambua. Vol. VI /2. Mei-Agustus 2007 :153-162
[11] Puslitbangtan. 2012. Padi Unggul Baru. Warta Penelitian dan Pengembangan Pertanian. Vol. 34 No. 1
[12] Ernawati, Rr. 2008. Potensi Hasil Empat Varietas Unggul Padi Sawah Pada Dua Lokasi di Karang Endah, Lampung. Seminar Nasional Padi 2008. Hal.621-627.
digilib.litbang.deptan.go.id. (Akses 3 April 2014)
[13] Dasmal. 2009. Karakteristik Varitas Padi Lokal Solok. BPTP Sumatera Barat. http://sumbar.litbang.deptan.go.id. (Akses 2 April 2013)
[14] Zen, S., H. Bahar, Dasmal, Taufik dan Maizir. 2000. "Pengkajian Varietas/Galur Padi Sawah Spesifik Selera Konsumen Sumatera Barat." *Laporan Akhir Kegiatan Pengkajian BPTP Sukarami Tahun 2000*.
[15] Anhar, A., I.L.E. Putri and. S.B. Etika. 2013. Stabilitas Mutu Beras Kelas Satu Terhadap Lokasi Tanam di Sumatera Barat. Laporan Penelitian. Universitas Negeri Padang.
[16] Muhadjir, F. 1998. Karakteristik Tanaman Jagung. Pusat Penelitian Tanaman Pangan, Bogor
[17] Becker, H.C. 1981. Correlation Among Some Statistical Measures of Phenotypic Stability. Euphytica. 30:835-840
[18] Suparyono dan S. Setyono. 1986. *Padi*. Jakarta: Penebar Swadaya
[19] Anhar , A. 2009. Stabilitas Hasil dan Mutu Beras Padi Sawah Pada Berbagai Lokasi Tanam di Sumatera Barat. Disertasi. Universitas Andalas, Padang
[20] Gomez, KA. And A.A. Gomez. 1995. Prosedur Statistik untuk Penelitian Pertanian. UI-Press, Jakarta
[21] Kanro, M.Z. dan Nasruddin. 2000. Interaksi tiga kultivar padi dengan tiga lokasi di Sulawesi Selatan. Zuriat 11(2):71-76.
[22] Nagai and Makino. 2009. Deffernces between Rice and Wheat in Temperature Respon of Photosynthesis and Plant Growth Plant Cell Physiol. 50 (4):744-755
[23] Yamakawa, H., T.Hirose, Kuroda and Yamaguchi. 2007. Comprehensive Expression Profilling of Rice Grain Filling-Related Genes under High Temperature Using DNA Microarra. Plant Physiology, May 2007, Vol.144 :258-277
[24] Lakitan, B. 2004. Dasar-Dasar Fisiologi tumbuhan. PT. Raja Gravindo Persada: Jakarta
[25] Anhar, A and A. Rasyad. 2007. Genotype X Environment Interaction and Yield Stability of Several Yield Component Among Adapted Rice Cultivars in West Sumatera. Jurnal Zuriat Vol 18 No.2. :99-105.
[26] Kim. K. S., B.L. Huh and K. M. Yoon. 1991. Effect of Shading at Heading Stage on Yield Component in Rice. J. Crop Sci. 36 (2):127-133

[27] Peng, S., J. Huang, J.E. Sheehy, R.C. Laza, R.M. Visperas, X. Zhong, G.S.Centeno, G. S. Khush, and K.G. Cassman. 2004. Rice yields decline with higher night temperature from global warming. PNAS vol.101 no. 27 July 6, 2004: 9971–9975

[28] Gibson L. R and G. M. Paulsen. 1999. Yield Components of Wheat Grown Under High Temperature Stress During Reproduktive Growth. Crop Science 39:1841-1846

[29] De Datta, S.K. 1981. Principle and Practices of Rice Production. John Wiley and Sons.

[30] Nguyen, N.V. 2005. Global climate change and Food security. International Rice Commission Newsletter (FAO). Vol. 54: 24-30